

Future Prospects for sub-meV Spectroscopy

Harald Sinn, Sector 30

APS upgrade planning meeting: sub-meV, July 20, 2006

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Sector 3, 9 and 30

Further contributions: Tim Sage,
Takeshi Egami, Gopal Shenoy, ...

APS upgrade: meV Spectroscopy

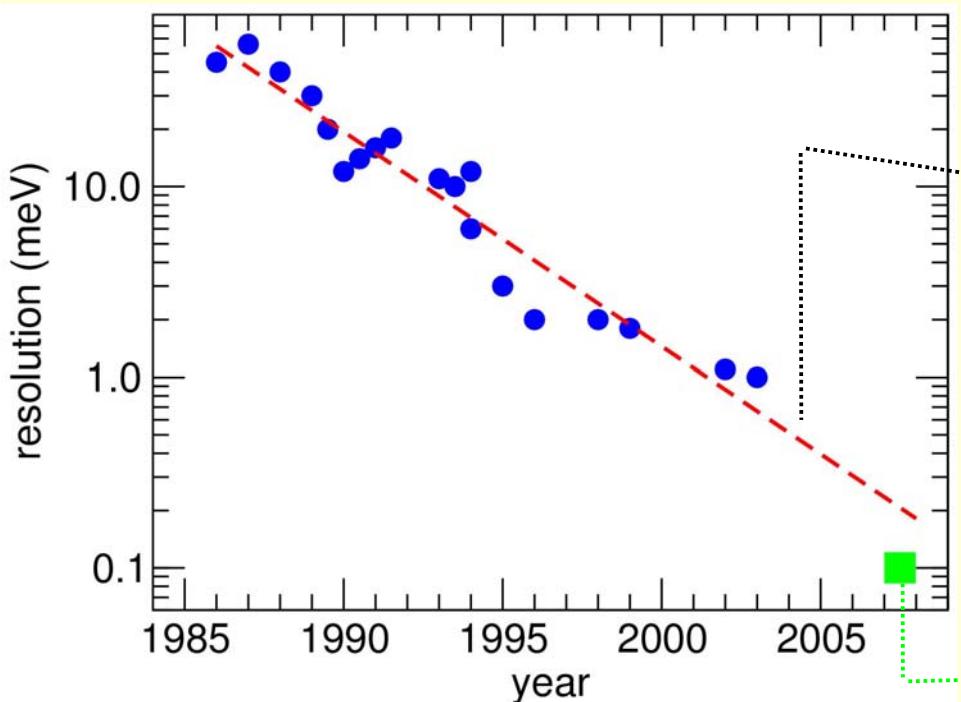
- longer straight sections (7 to 11 m) $\times 2$ 
 - superconducting short period undulators $\times 2$ 
 - 200 mA $\times 2$ 
- (timing important for nuclear resonant technique!)
- reduced emittance
 - better focusing
 - ‘easier’ monochromators

ERL option: > factor 10, sub- μm focus

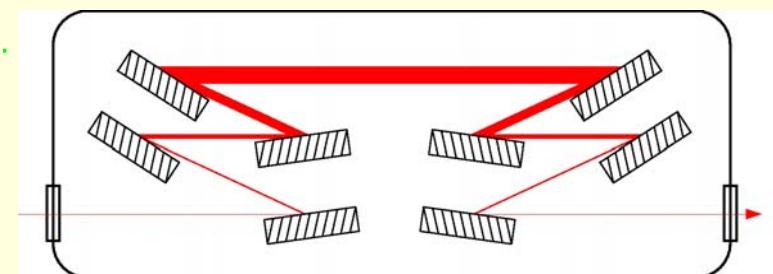


IXS resolution in the synchrotron radiation age

after E. Burkel, *Rep. Prog. Phys.* **63** (2000), modified



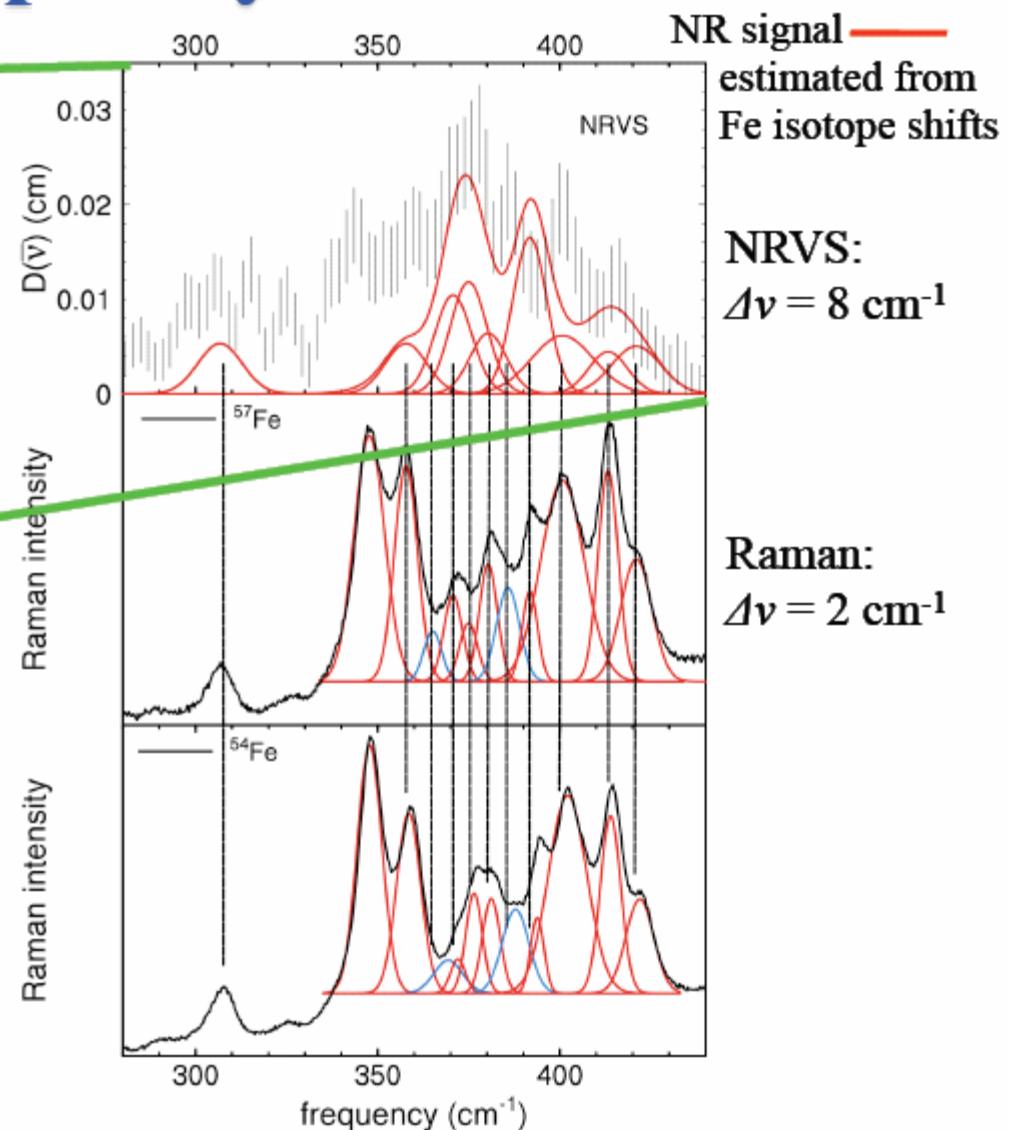
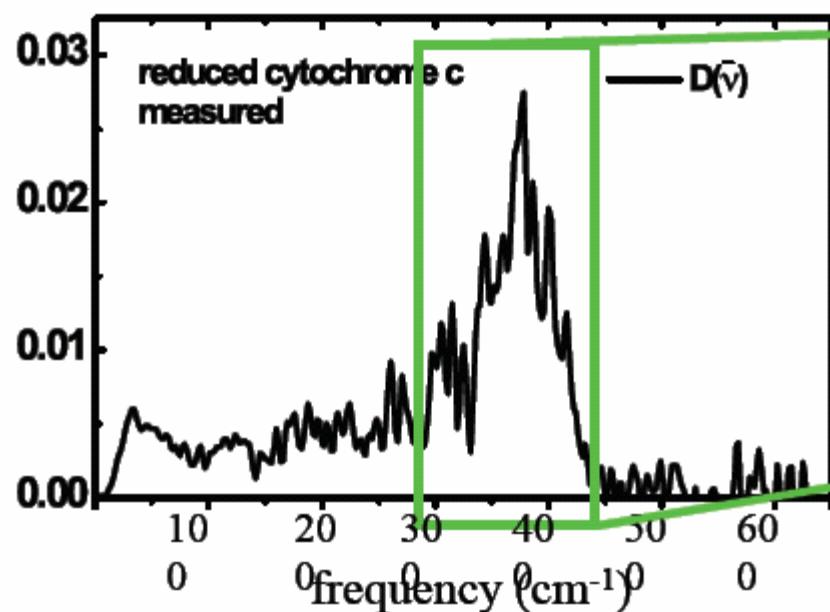
first cryogenic high-resolution monochromator
T.S. Toellner et al., *J. Synchrotron Rad.* **3** (2006) 211



Science with sub-meV

- 1.) IXS: resolve excitations in bio-polymers (membranes) and nanostructures (10-20 Å)
- 2.) IXS: High Pressure Phonons: better separation of elastic line, viscosity of geo-physical liquids
- 3.) NRS: resolve more complex spectra from proteins
- 4.) NRS: access longer time scales, e.g. protein conformational dynamics
- 5.) meV electron-emission-spectroscopy will be possible
- 6.) sub- μm focus: phonons at grain boundaries! (Gopal)

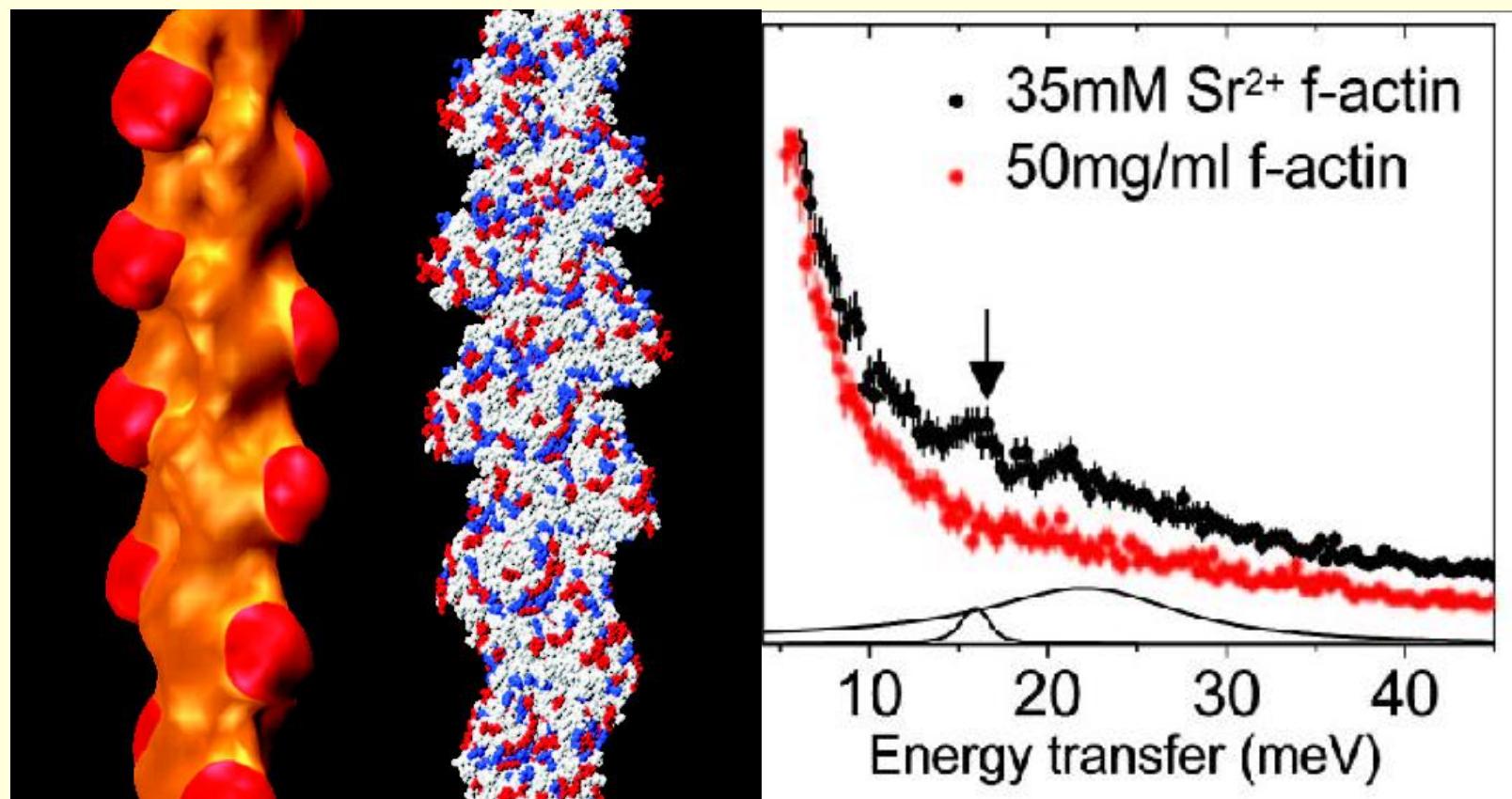
Energy resolution and spectral complexity



heme distortion in protein environment can lower symmetry, increasing spectral congestion (and information content)

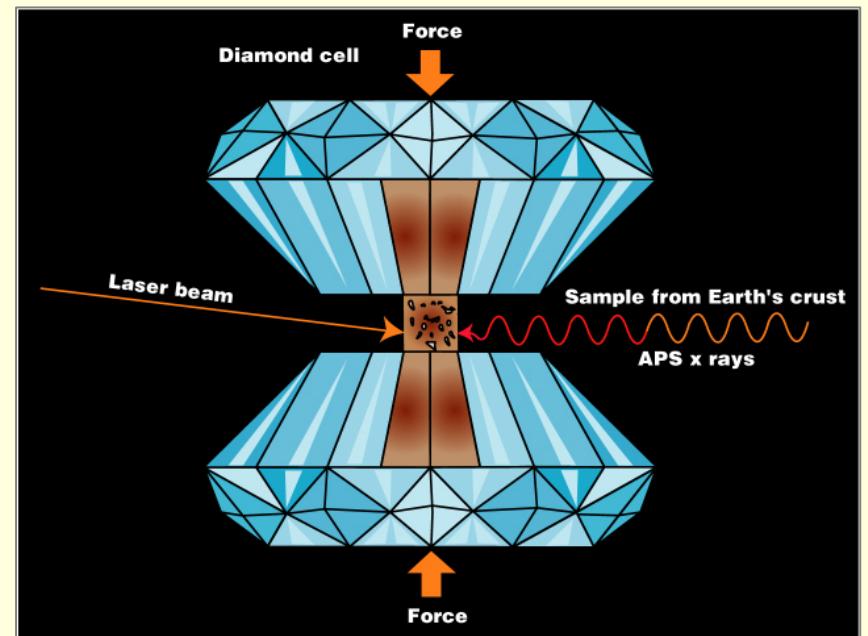
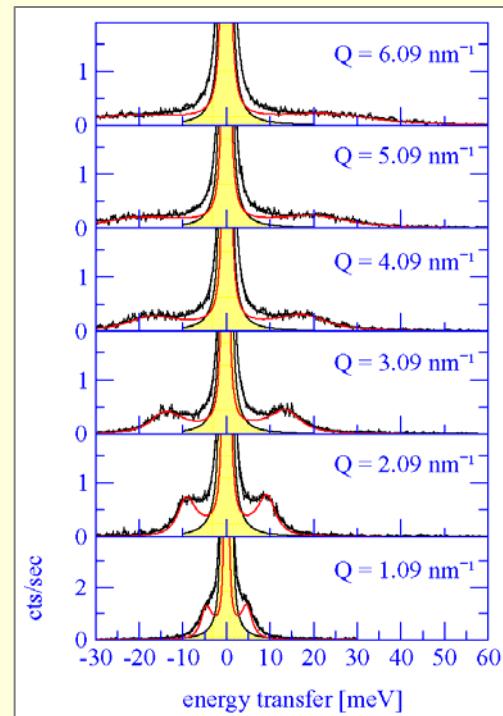
from Tim Sage

IXS: Excitations in Bio-Polymers



Gerard Wong et al. UIUC; T. Angelini et al. PNAS USA 103, 7962-7967 (2006)

IXS: High Pressure Phonons in Liquids: Viscosity!



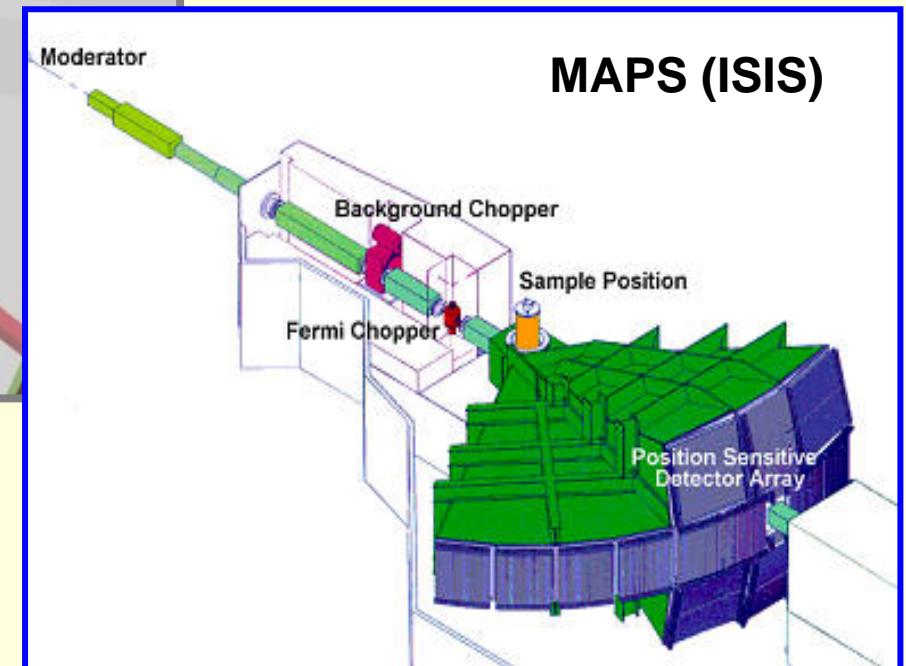
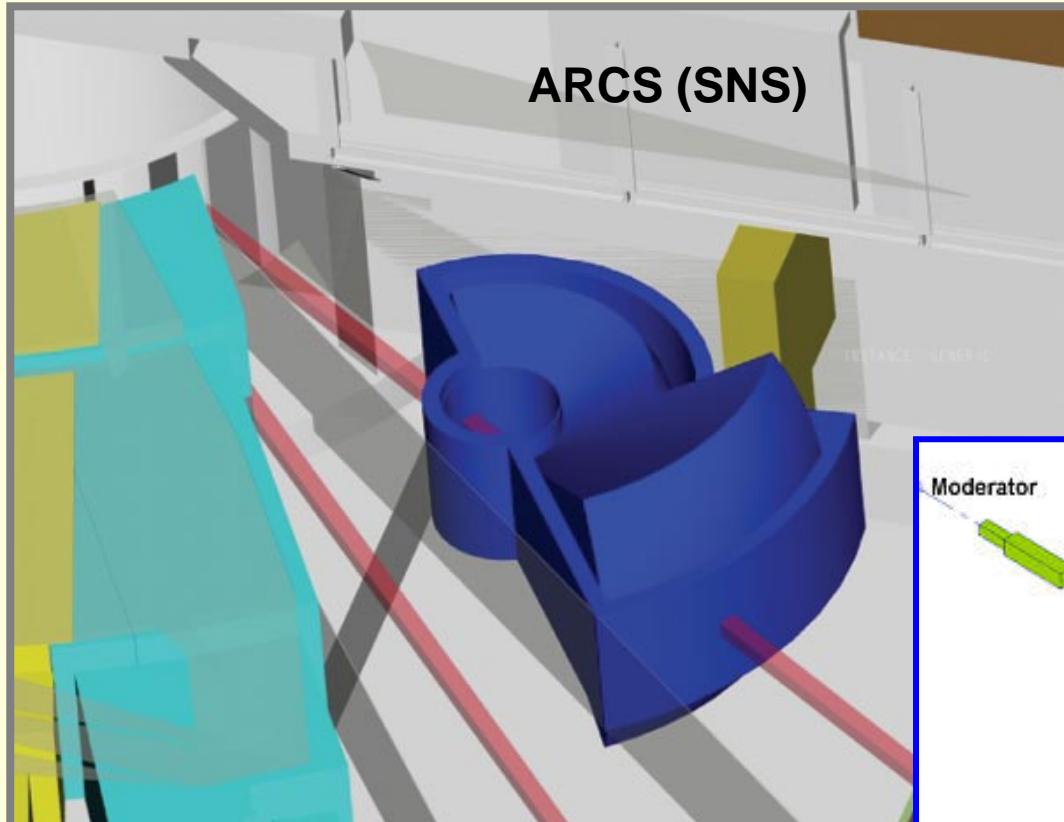
H. Sinn et al. Science 299, 2047 (2003)

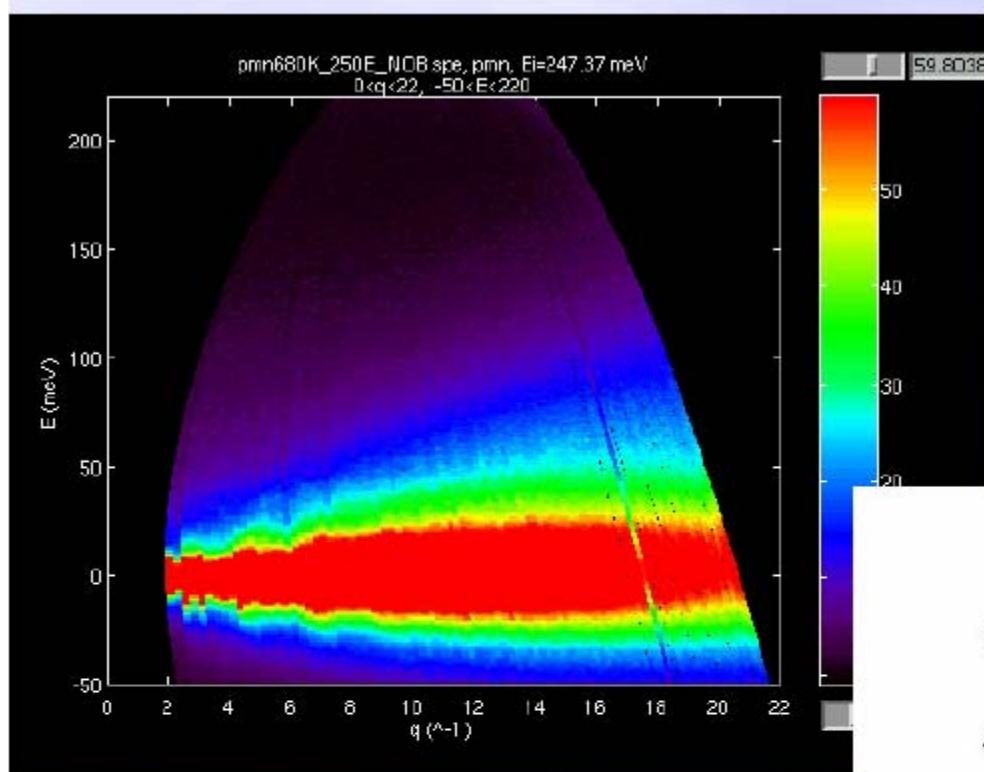
Sector 3: Alatas, Zhao et al.

HERIX today at Sector 30



Neutron spectrometers today

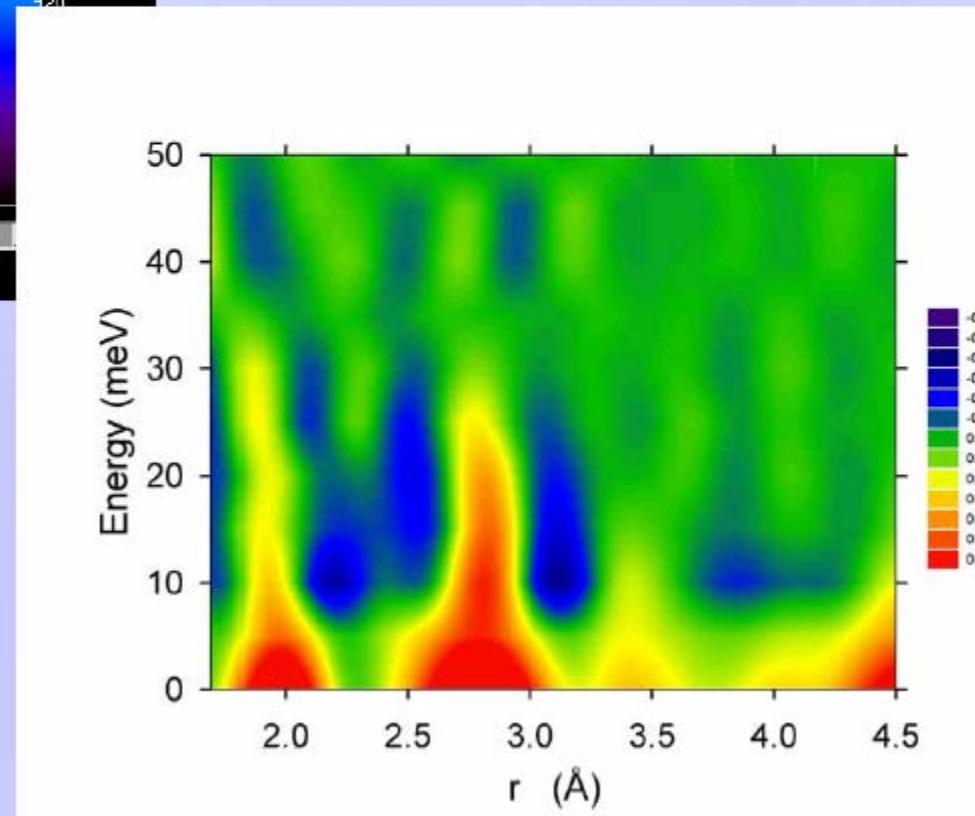




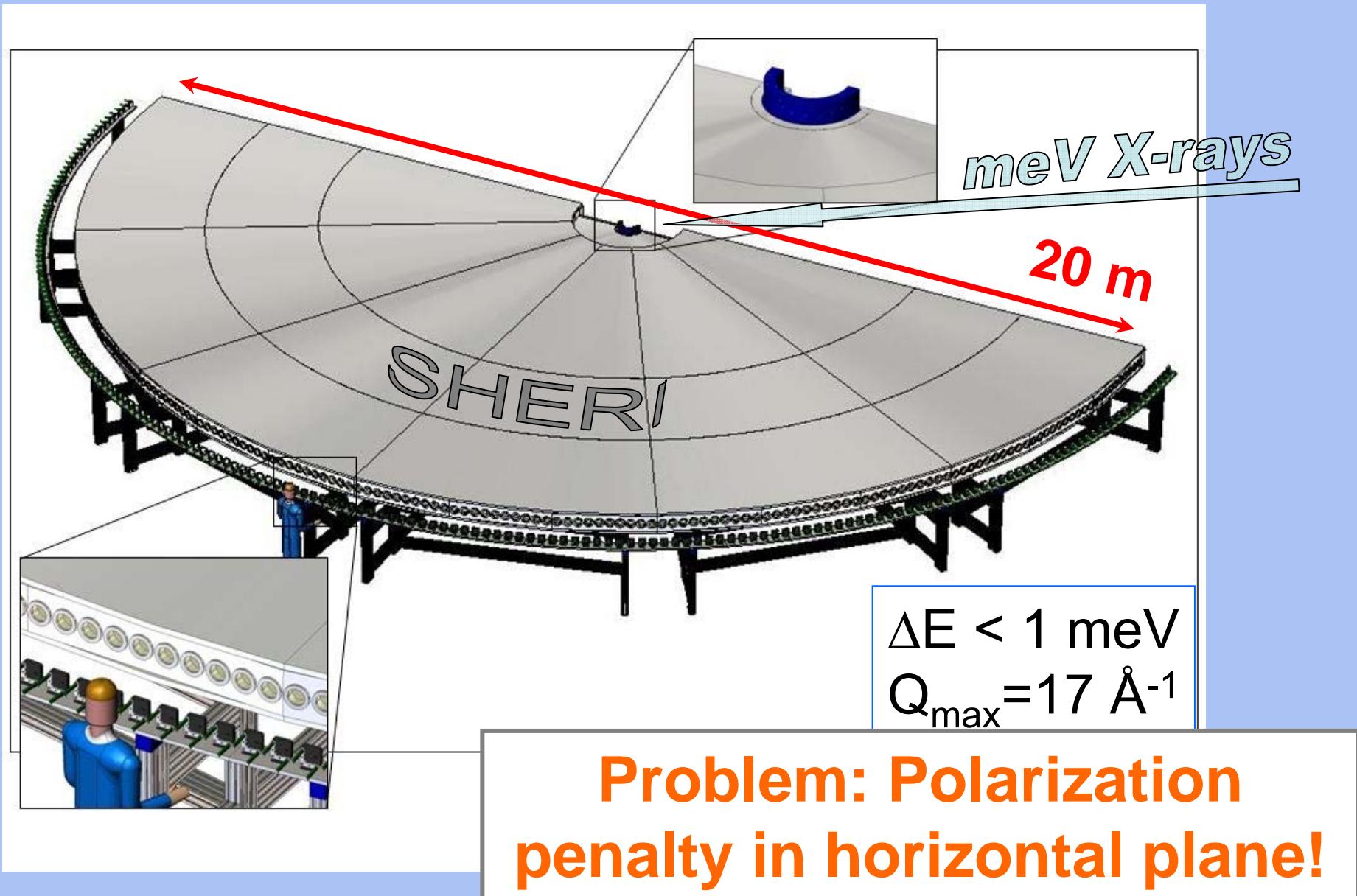
Fourier-transform from
Q space to real space

Dynamic pair
distribution function

Takeshi Egami: APS
colloquium Feb 2006



Ercan's dream machine:
SHERI : Super High Energy Resolution Instrument
0.6 meV @ 25.7 keV



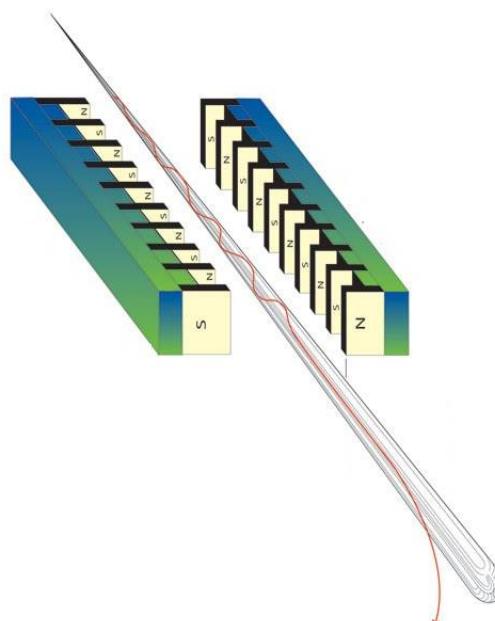
APS 2012

SHERI ?



2015: **APS-ERL!**

Horizontal Undulator



IXS spectrometers

